

We claim:

1     1.     A method for manufacturing a PIN diode, comprising the following steps:  
2             forming a p-area on a first surface of a substrate;  
3             forming an n-area on the first surface of the substrate spaced apart from the p-  
4     area;  
5             forming an intermediate area on the first surface of the substrate between the p-  
6     area and the n-area, wherein a doping concentration of the intermediate area is lower  
7     than a doping concentration of the p-area and lower than a doping concentration of the  
8     n-area;  
9             forming a first electrically conductive member on a side of the p-area, which  
10    faces away from the intermediate area; and  
11             forming a second electrically conductive member on a side of the n-area,  
12    which faces away from the intermediate area.

1     2.     The method in accordance with claim 1, comprising the following steps:  
2             providing the substrate and a device substrate; and  
3             wafer-bonding of the substrate and the device substrate, wherein the p-area, the  
4     n-area and the intermediate area are formed in the device substrate and insulated  
5     against the substrate.

1     3.     The method in accordance with claim 2, comprising the following steps:  
2             forming a trench in a section of the device substrate, which abuts on the  
3     intermediate area, wherein the trench extends from a surface of the device substrate,  
4     which faces away from the substrate, to a surface of the device substrate, which is  
5     opposite to the substrate; and  
6             filling the trench with an insulating material.

1     4.     The method in accordance with claim 3, wherein the trench is further formed  
2     in sections of the device substrate, which abut on the p-area and on the n-area.

- 1     5.     The method in accordance with claim 2, wherein the p-area or the n-area,  
2     respectively, is formed by  
3             forming a trench in the device substrate and filling the same with p-doped or n-  
4     doped polysilicon, respectively, or by  
5             implanting of p-material or n-material, respectively, in predetermined areas of  
6     the device substrate, or by  
7             forming a trench in the device substrate, introducing of p-material or n-  
8     material, respectively, into the same and diffusing of the introduced material into the  
9     areas of the device substrate surrounding the trench.
- 1     6.     The method in accordance with claim 1, further comprising the following step:  
2             forming an insulating layer above the surface of the p-area, the n-area, and the  
3     intermediate area, which faces away from the first surface of the substrate.
- 1     7.     The method in accordance with claim 1, further comprising the following step:  
2             forming of pads on the surfaces of the p-area and the n-area, which face away  
3     from the first surface of the substrate.

1     8.     A PIN diode comprising:  
2             a p-area on a first surface of a substrate;  
3             an n-area on the first surface of the substrate;  
4             an intermediate area on the first surface of the substrate between the p-area and  
5     the n-area, wherein a doping concentration of the intermediate area is lower than a  
6     doping concentration of the p-area and lower than a doping concentration of the n-  
7     area;  
8             a first electrically conductive member, which is arranged on a side of the p-  
9     area, which faces away from an intermediate area; and  
10            a second electrically conductive member, which is arranged on a side of the n-  
11    area, which faces away from the intermediate area.

1     9.     The PIN diode in accordance with claim 8, having an insulating layer on the  
2     substrate and a device substrate on the insulating layer, wherein the p-area, the n-area,  
3     and the intermediate area are arranged in the device substrate.

1     10.    The PIN diode in accordance with claim 8, comprising:  
2             a trench in a section of the device substrate, which abuts on the intermediate  
3     area, wherein the trench extends from a surface of the device substrate, which faces  
4     away from the substrate, to a surface of the device substrate, which is opposite to the  
5     substrate, and wherein the trench is filled with an insulating material.

1     11.    The PIN diode in accordance with claim 10, wherein the trench is arranged in  
2     sections of the device substrate, which abut on the p-area and on the n-area.

1     12.    The PIN diode in accordance with claim 11, wherein a shape of the  
2     intermediate area, which is determined by the trench, is essentially rectangular,  
3     wherein the p-area and the n-area are arranged on two opposite sides of the  
4     intermediate area.

1 13. The PIN diode in accordance with claim 11, wherein the shape of the  
2 intermediate area, which is determined by the trench, is essentially rectangular and, in  
3 addition, a further n-area or a further p-area is provided, wherein the n-area and the  
4 further n-area or the p-area and the further p-area, respectively, are arranged on  
5 opposite sides of the intermediate area and the p-area or the n-area, respectively, are  
6 arranged between the n-area and the further n-area or between the p-area and the  
7 further p-area, respectively, and being spaced apart from the same in the intermediate  
8 area.

1 14. The PIN diode in accordance with claim 12, wherein at least either the p-area  
2 or the n-area extend along a whole width of the intermediate area.

1 15. The PIN diode in accordance with claim 11, wherein a shape of the  
2 intermediate area, which is determined by the trench is essentially trapezoidal, wherein  
3 the p-area extends along one of the parallel sides of the intermediate area, and wherein  
4 the n-area extends along the other of the parallel sides of the intermediate area.

1 16. The PIN diode in accordance with claim 11, wherein a shape of the  
2 intermediate area, which is determined by the trench, is essentially circular, wherein  
3 either the p-area or the n-area is arranged in the shape of a circle along the edge of the  
4 intermediate area, wherein the n-area or the p-area, respectively, is essentially  
5 arranged in the center of the intermediate area and wherein the second electrically  
6 conductive member or the first electrically conductive member, respectively, is  
7 arranged in its center.

1 17. The PIN diode in accordance with claim 8, further comprising:  
2 a further insulating layer, which covers surfaces of the p-area, the n-area, and  
3 the intermediate area, which face away from the substrate.

1 18. The PIN diode in accordance with claim 8, wherein a first pad is conductively  
2 connected to the p-area and a second pad is conductively connected to the n-area,  
3 wherein the two pads are arranged at the surfaces of the p-area and the n-area, which  
4 face away from the first surface of the substrate.

1 19. The PIN diode in accordance with claim 8, wherein the distance between the p-  
2 area and the n-area is more than 30  $\mu\text{m}$ .